Wide-area Technologies and Services in the Trans-Pacific High Data Rate (HDR) Satellite Communications Experiments

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Government, academic, and industry teams in Canada, Japan and the United States have begun a series of Trans-Pacific experiments to develop and demonstrate the role of satellite communications in the Global Information Infrastructure (SC/GII). These experiments and demonstrations will help explore and develop satellite transmission techniques, standards, and protocols in order to determine how best to incorporate satellite links with fiber optic cables to form high performance global telecommunications networks. The *Trans-Pacific High Data Rate (HDR) Satellite Communications Experiments* were initiated in 1996 as the result of a proposal by the Japan-U.S. Science, Technology and Space Application Program.

Following the successful *Trans-Pacific High Definition Video (HDV) Experiment* in establishing the first two-satellite-hop broadband Asynchronous Transfer Mode infrastructure to conduct digital HDV post-production activities between Tokyo and Los Angeles, the team is preparing to demonstrate the application of global-scale high performance communications networks in tele-medicine and distance-education using Internet Protocol (IP) based technologies. The use of popular IP-based technologies helps involve students and perhaps the general public in the important and exciting opportunities of using satellite communications in the Global Information Infrastructure and the Next Generation Internet (NGI). The team also have a unique opportunity to compare application performance over both the two-hop satellite links (Intelsat and NTT N-Star) and the under-sea cables via the Asia-Pacific Advanced Network (APAN).

As people, organizations, and resources become more distributed and mobile in nature, a global information infrastructure involving broadband satellites serves to bridge wide geographical distances and make information and equipment resources available to any one, any where, at any time. In such an environment, the ability to effectively share resources and capabilities in a distributed manner -- on a global scale -- becomes important, and the distinction between communications networks and distributed systems becomes less clear. The HDV experiment demonstrated the creation of the virtual digital studio and the feasibility of real-time, remote cinematography post-production. The *Visible Human* tele-medicine and *Remote Astronomy* distance education demonstrations and their use of distributed systems technologies provide an example of how students and perhaps the general public around the world can work as a virtual team under one roof, using resources thousands of miles away as if they were next to each other. These activities help validate emerging technologies and service models in a global information infrastructure, and can span to include activities in global-scale virtual presence, solar system internetwork, disasters mitigation, and other high data rate, distributed applications.

This paper describes the technologies and services used in the experiments and demonstrations using the trans-Pacific high data rate satellite communications infrastructure, and how the environment tasks protocol adaptability, scalability, efficiency, interoperability, and robustness. In subsequent work, the use of IPv6 differentiated services, [reliable] multicast, high-definition multi-party conferencing and data sharing, and increasing types of distributed application services over a combination of broadband satellite links and terrestrial dense-mode wavelength division multiplexing connections will be examined.

In the United States, the GIBN project is coordinated by the White House National Economic Council, the National Science Foundation, and the National Aeronautics and Space Administration. In Japan, by the Ministry of Posts and Telecommunications and the Communications Research Laboratory. And in Canada by the Communications Research Centre and by the Teleglobe Incorporated.